IM09.22s

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

INTERMEDIATE MATRICULATION LEVEL
2022 SECOND SESSION

SUBJECT:	**Engineering Drawing and Graphical Communication**
DATE:	2nd September 2022
TIME:	9:00 a.m. to 12:05 p.m.

Directions to Candidates

Write your index number where indicated at the top of all drawing sheets.

Only scientific calculators may be used. Programmable calculators are not allowed.

Unless otherwise stated:

a. B.S. or equivalent (ISO) recommendations should be adopted throughout your answers;
b. all dimensions are in millimetres, unless otherwise stated;
c. all answers are to be accurately drawn with instruments;
d. all construction lines must be left in each solution;
e. drawing aids may be used.

Dimensions not given should be estimated.

Careful layout and presentation are important.

Marks will be awarded for accuracy, clarity and appropriateness of constructions.

Colour/shading may be used where appropriate.

Section A: Attempt any **FOUR** questions from six.

Section B: Attempt any **ONE** question from three.

Section C: Attempt any **ONE** question from three.

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SECTION A

Attempt any **FOUR** questions from this section.

Question 1

The 60 mm diameter circle shown in Figure 1a is to roll forward for two revolutions. The circle is to roll clockwise, for half a revolution on the outside of the circumference of an arc 'A-B'. For the next movement, the circle makes contact with an arc 'C-D', and rolls anticlockwise, for half a revolution on the inside of the circumference of the arc. Finally, the circle rolls clockwise on the straight inclined line 'E-F' for a complete revolution.

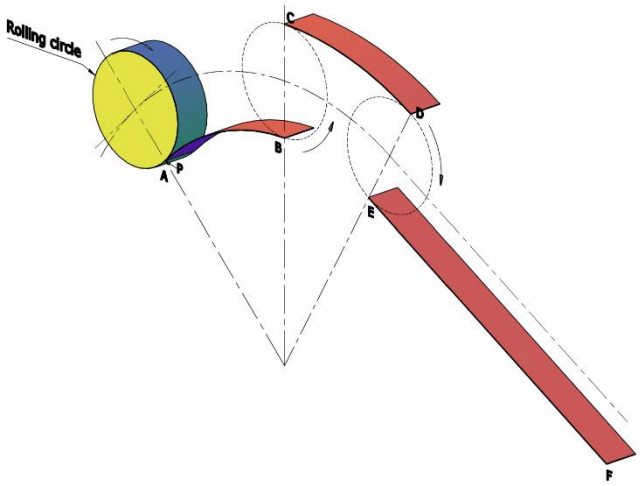

Figure 1a

Point 'P' is situated on the circumference of the 60 mm diameter circle, initially in contact with point 'A'.

a) Copy, full size, Figure 1b and construct the locus of the point 'P' when the circle rolls;
   i. for half a revolution on the base circle, from the initial position 'A' to the point 'B'. (4)
   ii. for another half of a revolution on the inside of the base circle, from the point 'C' to the point marked 'D'. (4)
   iii. for one revolution on the inclined line, from the point marked 'E' to the end of the line marked 'F'. (3)

b) Name the technical terms for the **THREE** types of curves. (2)

(Total: 13 marks)

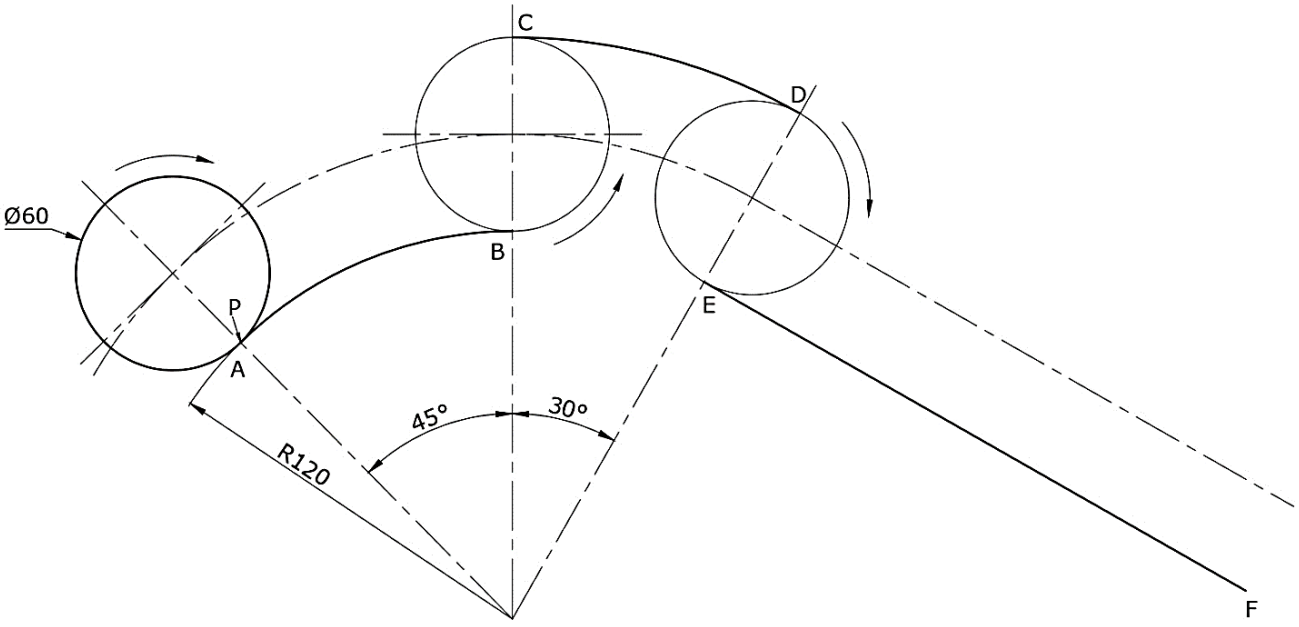

Figure 1b

Question 2

A pictorial view of a metal block is shown in Figure 2a and two orthographic views of the block are shown in Figure 2b. The metal block stands on its rectangular base and the axis of the 60 mm diameter drilled through hole, is parallel to the horizontal plane. One end of the block is machined sloping at an angle of 60° to the horizontal plane. The block is finally machined to an elliptical cross – section.

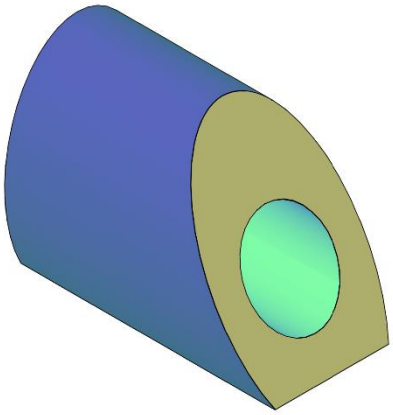

Figure 2a

a) Copy, full size, the given front elevation of the machined block shown in Figure 2b. (2)

b) Construct the elliptical sectional end elevation. (3)

c) Construct neatly the plan by showing the:

   i. the profile of the sloping end of the block; (3)
   ii. the shape of the through hole. (2)

d) Draw the true shape of the hole of the sloping end. (3)

(Total: 13 marks)

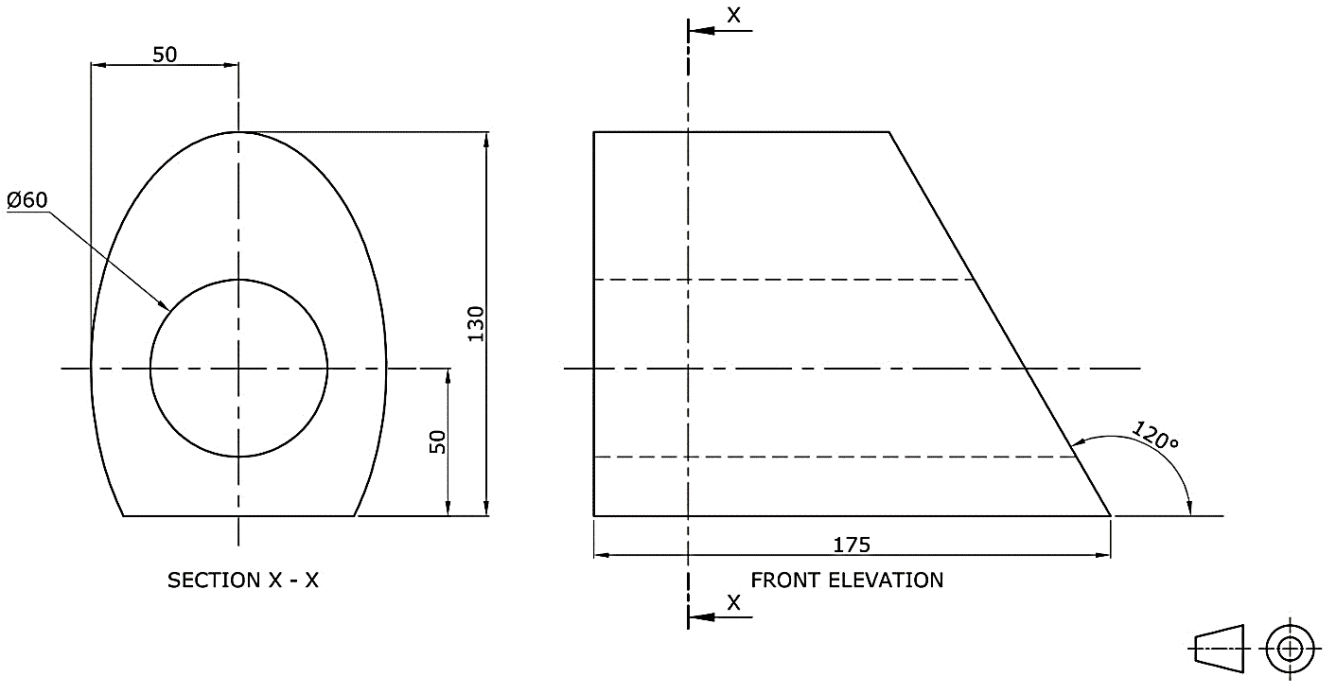

Figure 2b

Please turn the page.

Question 3

Figure 3a and Figure 3b show a right rectangular prism resting on a horizontal plane. The rectangular prism is placed with its 120 mm side at an angle of 30° to the vertical plane. The other side is 80 mm long. A triangular prism is to intersect the rectangular prism as shown. The side AB of the triangle is 110 mm, the side BC is 80 mm and the side CA is 120 mm long at an angle of 30° to the horizontal plane.

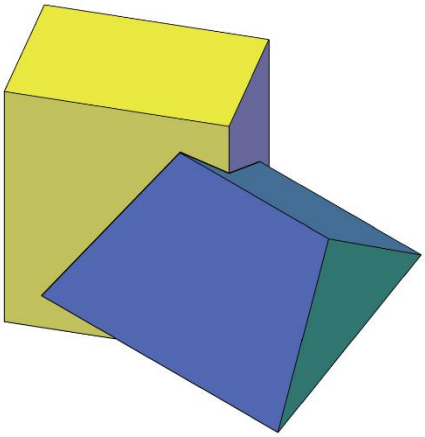

Figure 3a

a) Copy, full size, the three views shown in Figure 3b. (3)

b) Study the pictorial view, noting the contours of the two prisms and label by numbers/letters showing the order and positions of the sequence. Locate the points of intersections. (4)

c) Show the lines of intersection on the front elevation, between the vertical rectangular prism and the horizontal triangular prism, using bold and dashed lines. (6)

(Total: 13 marks)

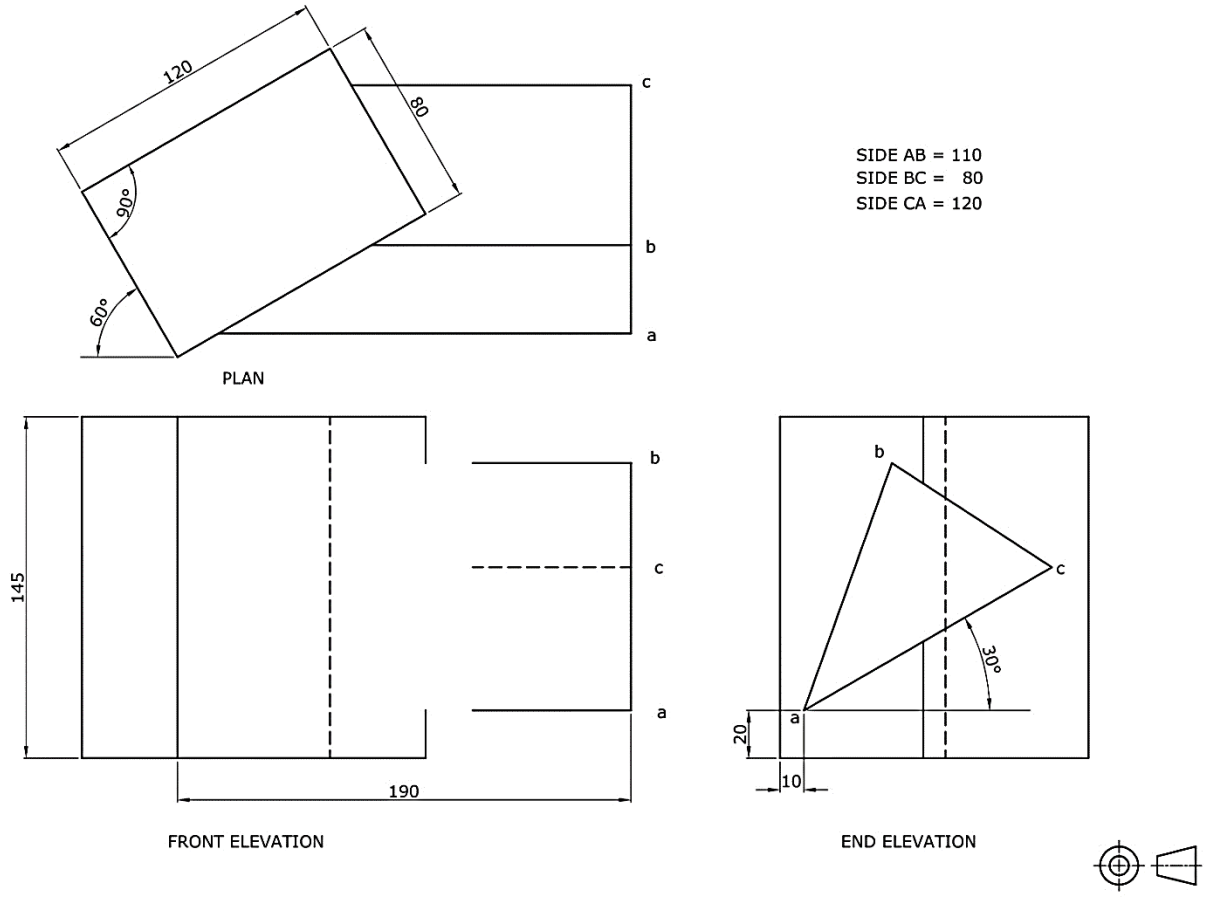

Figure 3b

Question 4

Figure 4a shows a right cylinder stands on the horizontal plane on its 80 mm diameter base in front of a semi-cylinder of the same diameter and height.

A right cone with a 120 mm diameter base and 120 mm perpendicular height, standing on the same horizontal plane, is placed touching the two solids.

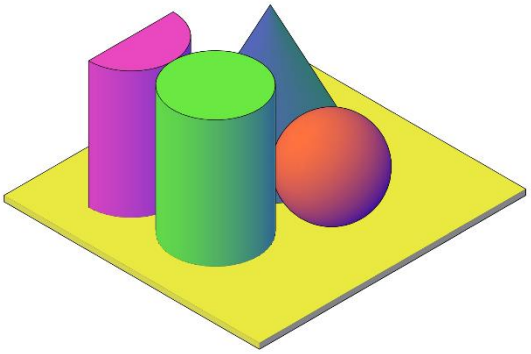

Figure 4a

a) Draw, full size, Figure 4b, the plan and the elevation of the cylinder, semi - cylinder and cone, showing in each view the line and points of contact between them. (4)

b) An 80 mm diameter sphere is placed on the horizontal plane and positioned in mutual contact with the cone and the cylinder. Show neatly the construction required so as to present on the two views **all** points of contact between them. (9)

(Total: 13 marks)

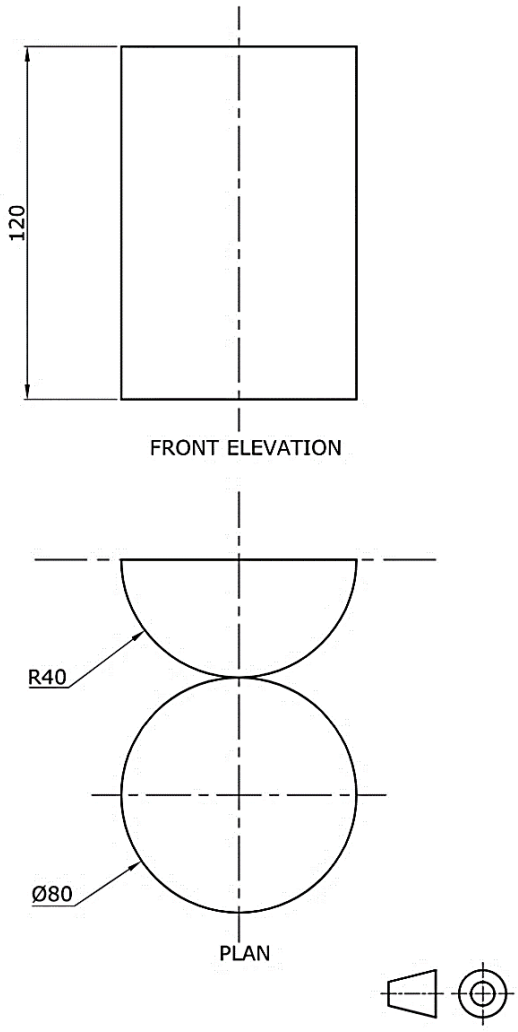

Figure 4b

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Question 5

A device for feeding material into a machine is shown in the illustration in Figure 5a.

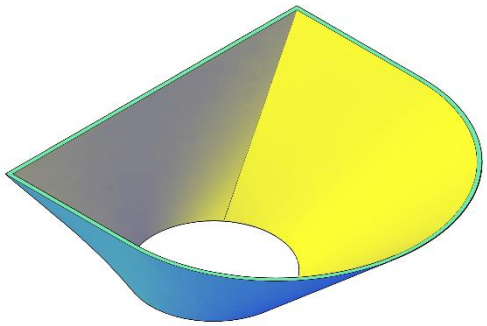

Figure 5a

a) Copy, full size, the two views shown in Figure 5b. (2)

b) Show on the two views drawn, how you intend to divide the transition piece for the surface development. Label the quadrilateral and triangles using letters and numbers. (2)

c) Using a clear acceptable method, find the true lengths for the pattern. (3)

d) Construct, half the surface development of the pattern. (6)

(Total: 13 marks)

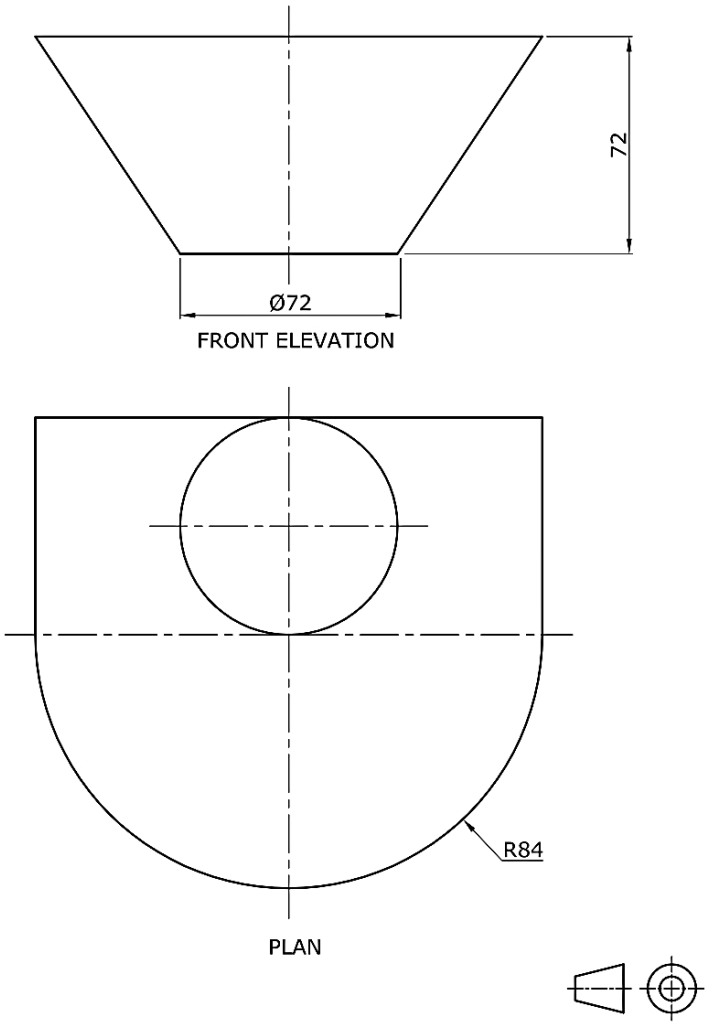

Figure 5b

Question 6

A 5 m ladder rests against a smooth sloping wall. A vertical load stands on it as indicated in Figure 6a. The presented load includes the weight of the ladder

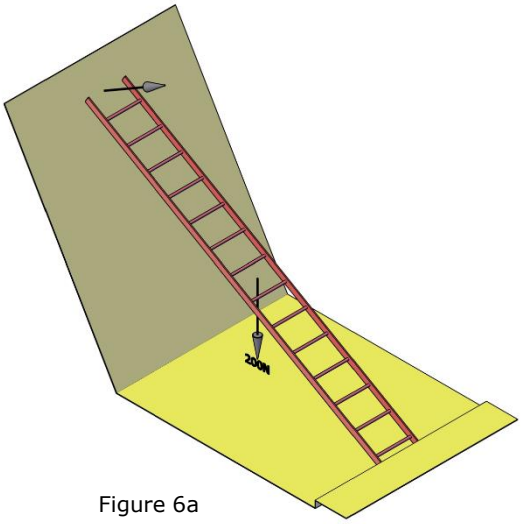

Figure 6a

a) Draw, the space diagram shown in Figure 6b to a scale of 60 mm = 1 m. (3)

b) Draw a small sketch showing how the three forces meet at point O (point of concurrency). (2)

c) Using a scale of 10 mm = 10 N, construct a vector diagram of the three concurrent forces. (4)

d) Determine, the magnitude and direction of;
   i. the Reaction at the top of the ladder; (2)
   ii. the Resultant Reaction at the bottom end of the ladder. (2)

(Total: 13 marks)

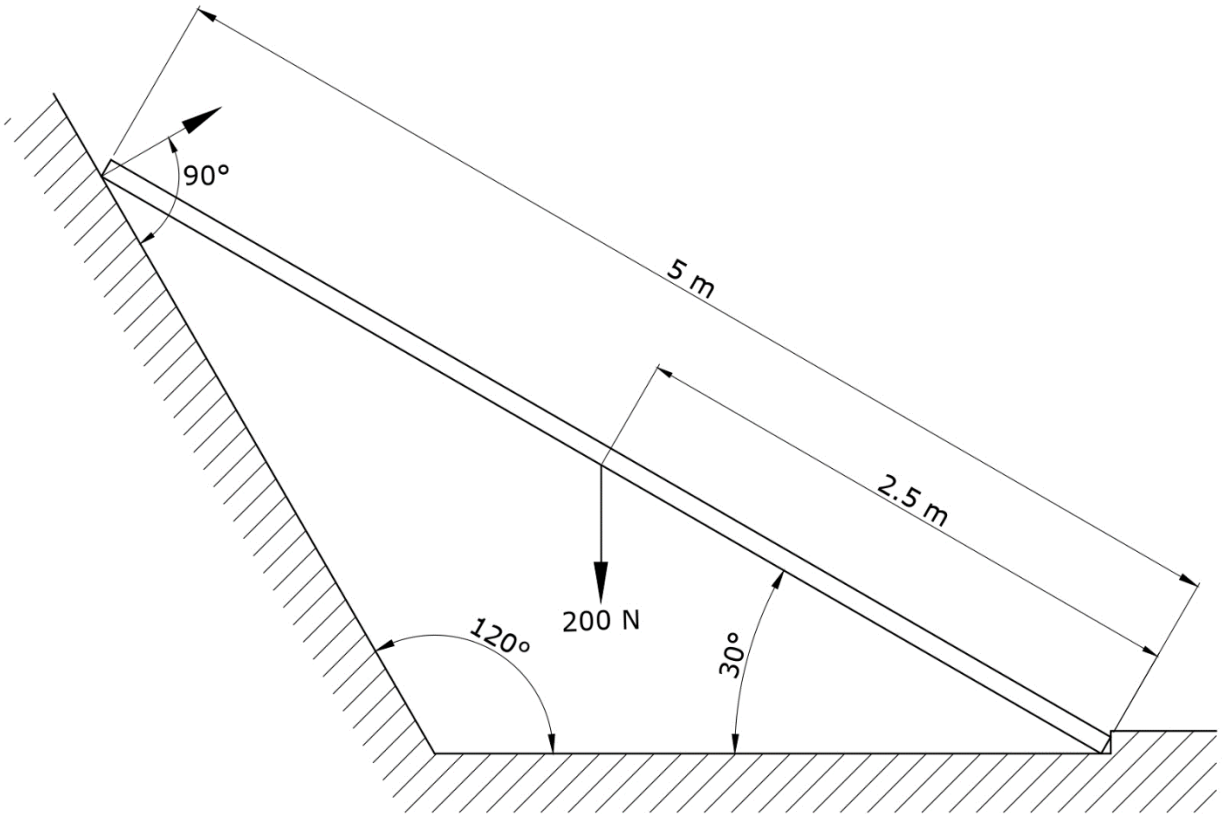

Figure 6b

Please turn the page.

SECTION B

Attempt only **ONE** question from this section.

Question 7

An illustration of a Bench Clamp device, in the form of an exploded view showing individual parts, is presented in Figure 7a on the next page.

The assembly comprises a body, a bush, a bolt and washer, a knob and stem secured with a locking pin.

Detailed orthographic drawings of each item that form part of the bench clamp device are shown in Figure 7b on the attached A3 papers.

The following steps explain how the bench clamp device is assembled:

- the upper end 42 mm diameter x 80 mm of the shouldered collar bush (Item 2), is inserted into the 42 mm diameter x 80 mm bore of the body (Item 1) with the collar surface in contact with the lower 70 mm diameter x 42 diameter surface;
- the M28 hexagonal headed bolt (Item 4) is inserted in the 28 mm inner diameter of the 70 mm diameter x 12 mm thick washer (Item 3);
- the bolt and washer are inserted into the 28 mm inner bore of the bush (Item 2). The protruding threaded end M28 x 42 mm shall be tightened into an M28 tapped hole on a bench table (not shown);
- the knob (Item 6) is inserted in the 28 mm diameter x 32 mm unthreaded top end of the stem (Item 5);
- the 8 mm drilled hole of the knob and the 8 mm drilled hole of the stem are aligned and the 8 mm diameter pin (Item 7) is press fit into the 8 mm diameter bore, securing the knob to the stem;
- the M28 outside threaded portion of the stem is screwed into the M28 tapped hole of the body bracket.

Draw, full size, a sectional elevation along the horizontal X - X of the complete assembly.

Notes:

- Show the assembly with the 50 mm diameter face of the knob screwed down 20 mm above the 50 mm diameter face of the body (Item 1).

- Show the knob (Item 6) to stem (Item 5) installation as a local section detail.

(Total: 24 marks)

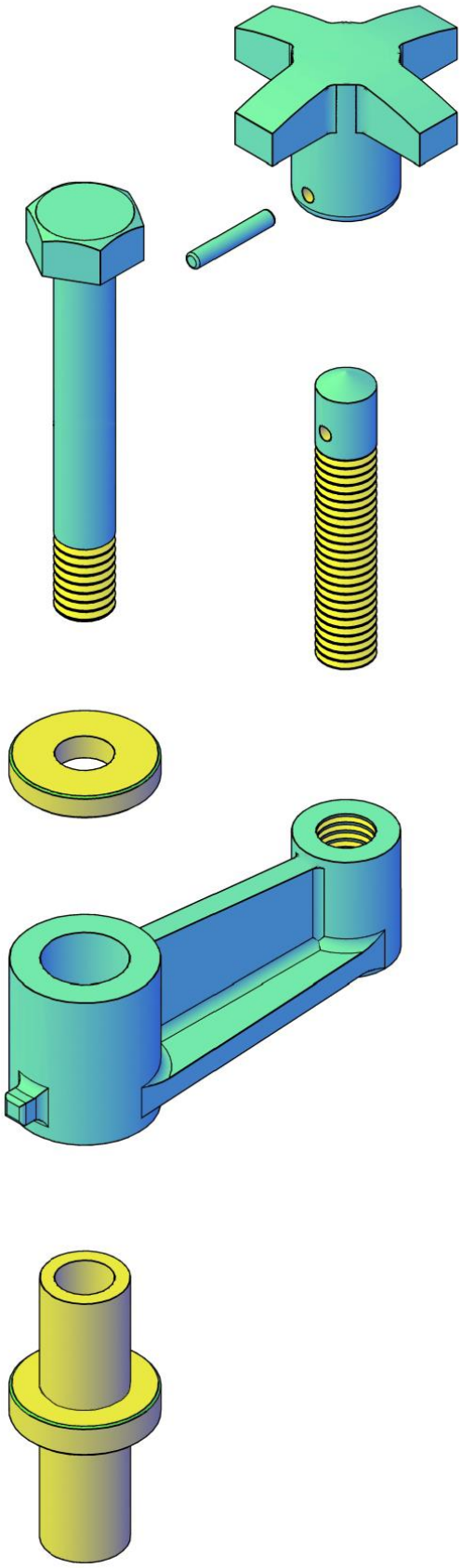

Figure 7a

Please turn the page.

Question 8

Some of the details of the components required to make up the machanism to operate the sluice valve are given in Figure 8a. The parts shown are a webbed frame with a centrally cylindrical hollow piece, a spindle passing through the hollow cylinder and two identical bushes. The packing between the bushes is not included.

Detailed orthographic drawings of each item that form part of the sluice valve mechanism are shown in Figure 8b on the attached A3 papers.

a) Draw a sectional front elevation on the section line X-X, of the assembly of the frame, the spindle and the two bushes. The sectional view is to show the bushes fitted to the frame in the bored cylindrical hole and the spindle assembled to the bushes. The 60 mm diameter shoulder of the spindle is to rest agaist the base of the frame and the base of the lower bush. The lower bush, inserted in the 80 mm diameter bore, fits in the lower step of the bored cylindrical hole. (20)

b) Assemble the second bush aligning point P of the bush with the point marked P of the frame. (4)

Do **not** include hidden detail. Include suitable fillet radii.

(Total: 24 marks)

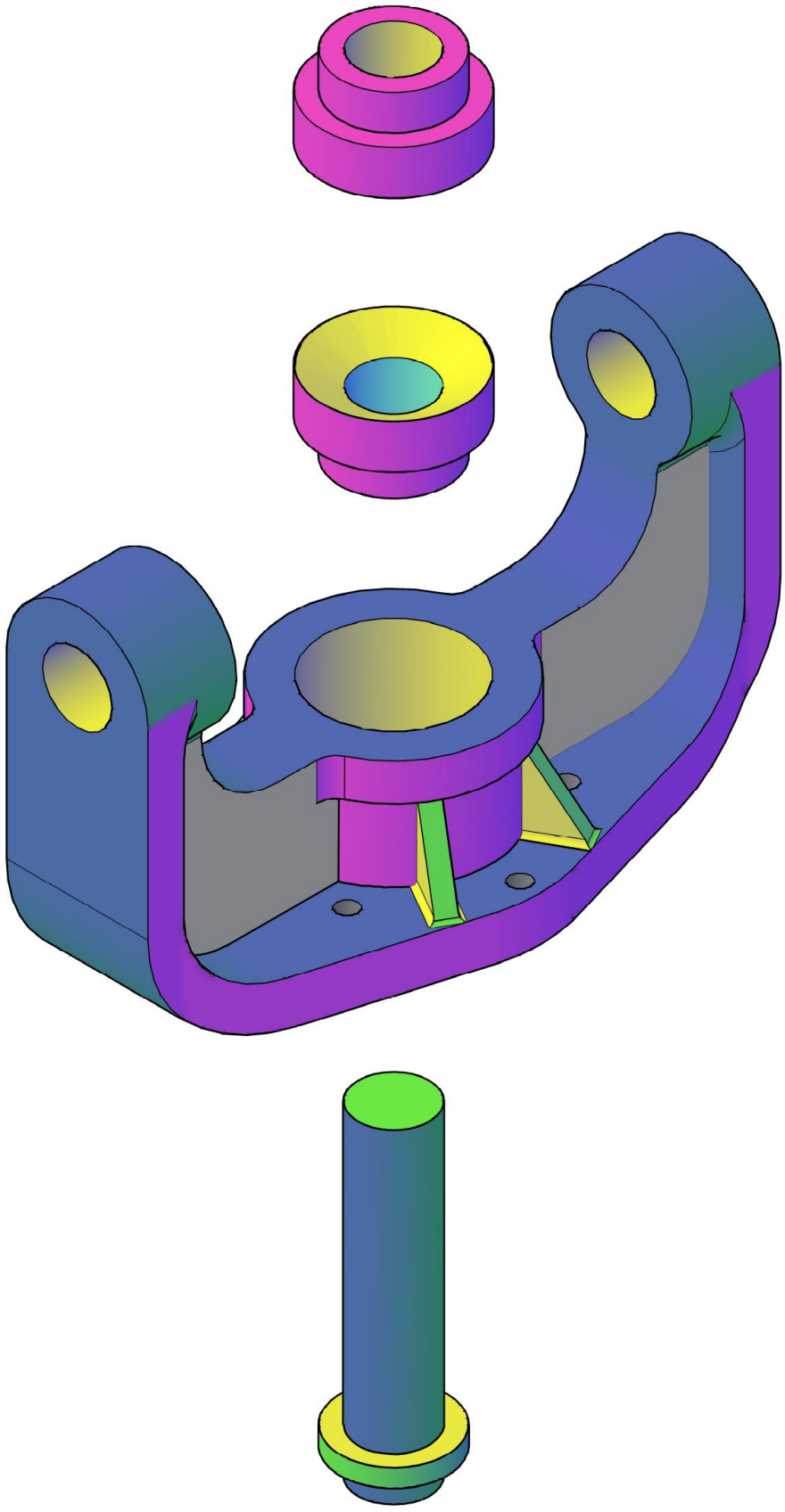

Figure 8a

Please turn the page.

Question 9

A pictorial view of a proposed disc cam is shown in Figure 9a. The profile of the cam is formed by constructing the involute of three sides of a square 40 mm side, two quadrants and a simple harmonic motion graph.
A complete plan showing the thickness of the cam is shown in Figure 9b. The incomplete front elevation of the cam indicates the position of the centre of the 40 mm diameter circle and the square by a dashed line.

a) Construct the:
   i. involute of the three sides of the square AB, BC and CD; (4)
   ii. quadrant AG and EF; (2)
   iii. simple harmonic motion displacement graph GF on the base line OH. (6)

b) Draw an auxiliary elevation, as seen when looking in the direction of the arrow S. (12)

Do **not** include hidden detail on the auxiliary elevation.

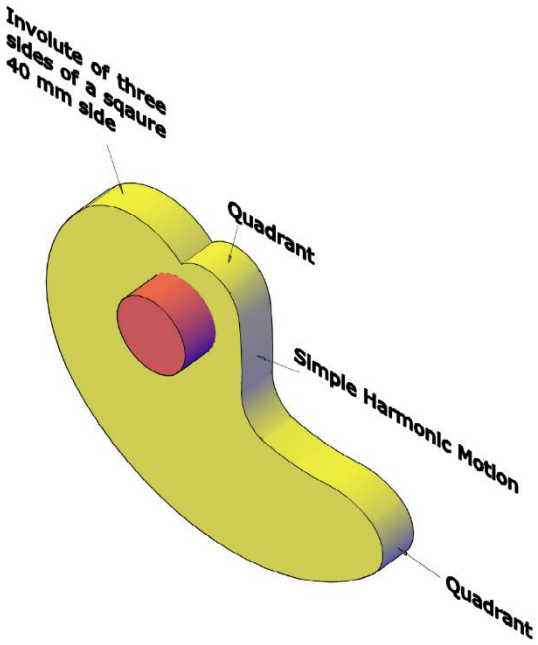

Figure 9a

(Total: 24 marks)

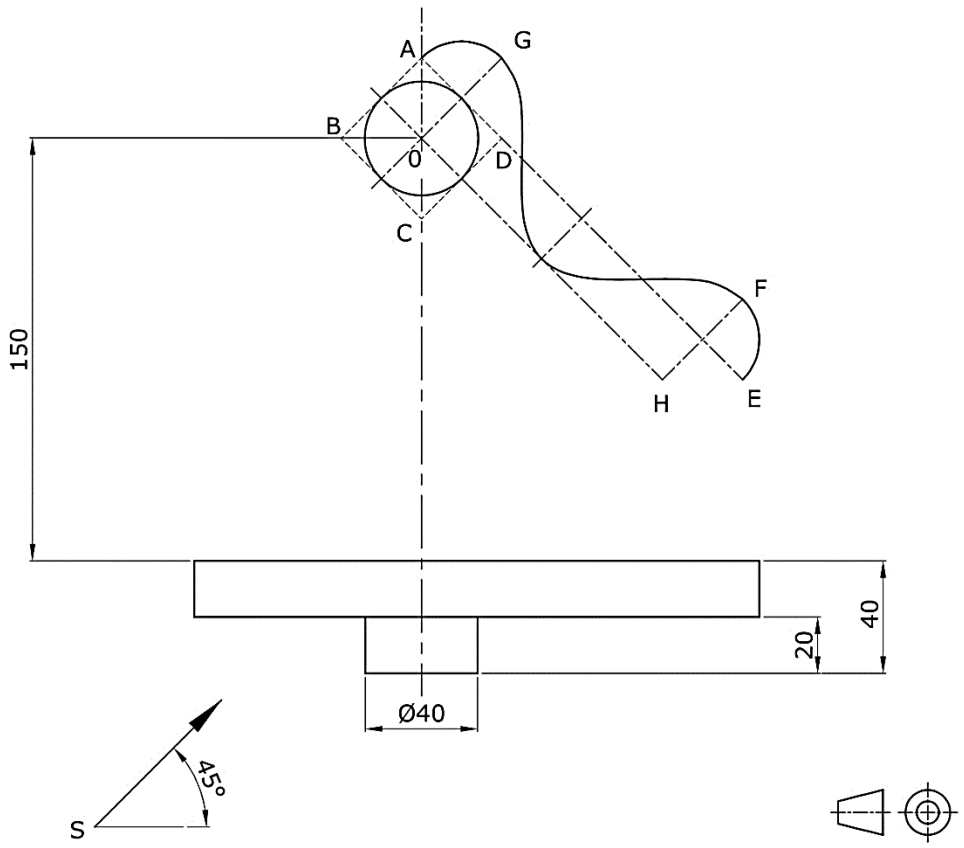

Figure 9b

SECTION C

Attempt only **ONE** question from this section.

Question 10

A pictorial drawing of a reading corner is shown in Figure 10a. An orthographic projection of the reading corner is shown in Figure 10b. The reading corner consists of a wooden library with side and overhead shelves, a window for natural light and a sofa.

a) Use the dimensions given in the orthographic projection to construct an estimated two-point perspective of the reading corner. The viewing direction required is indicated by the arrow in the plan. Use the suggested layout of the two-point perspective shown in the Figure 10c. (21)

b) Render in colour your drawing to enhance its presentation. (3)

(Total: 24 marks)

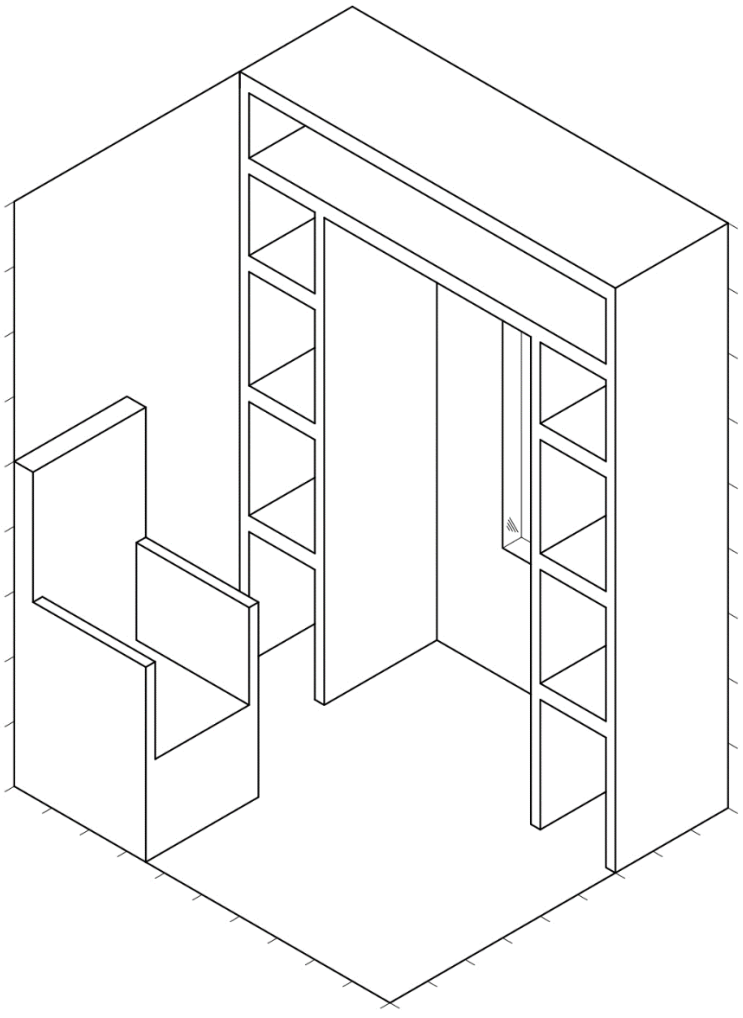

Figure 10a

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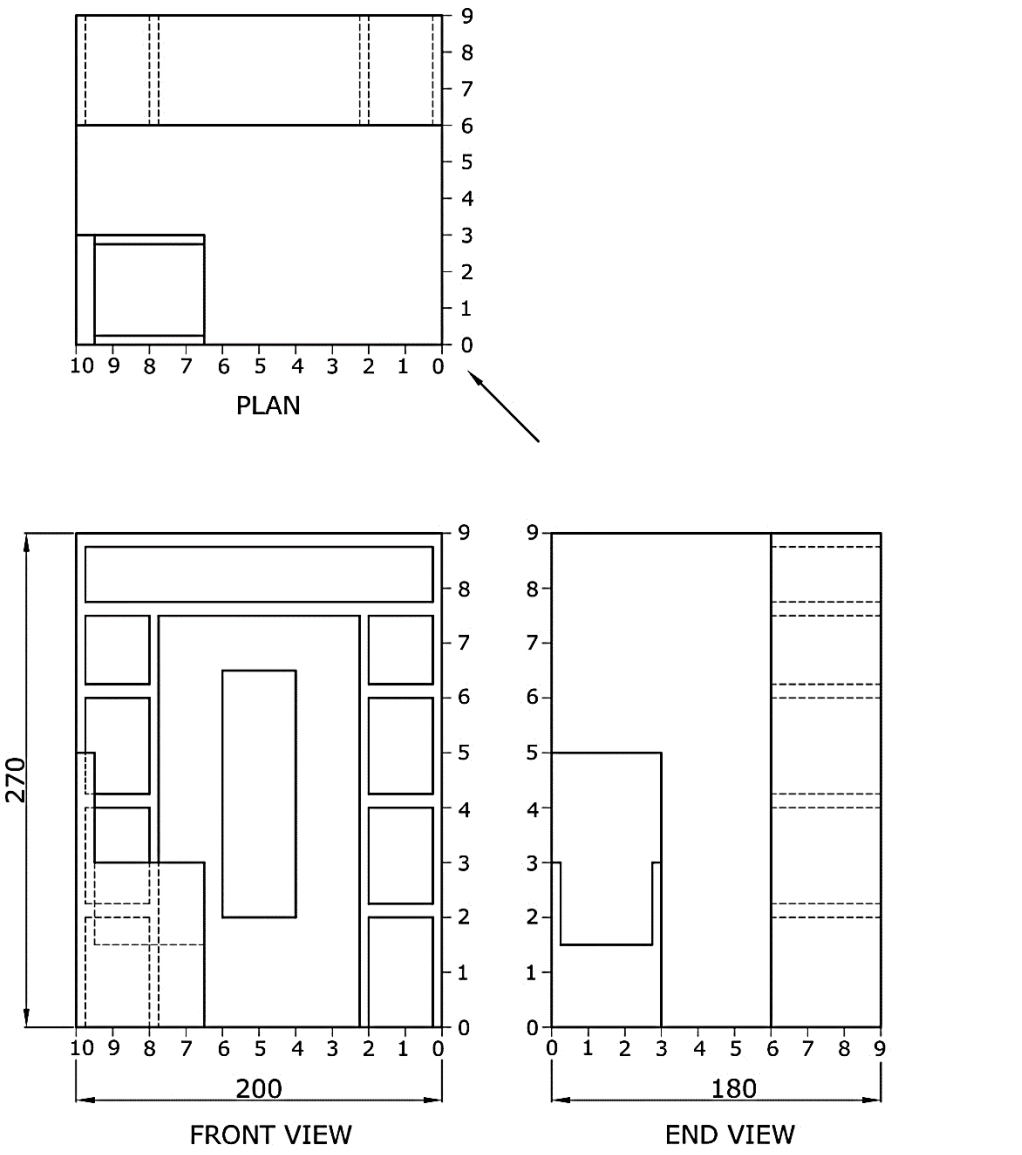
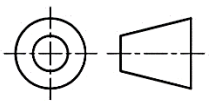


Figure 10b



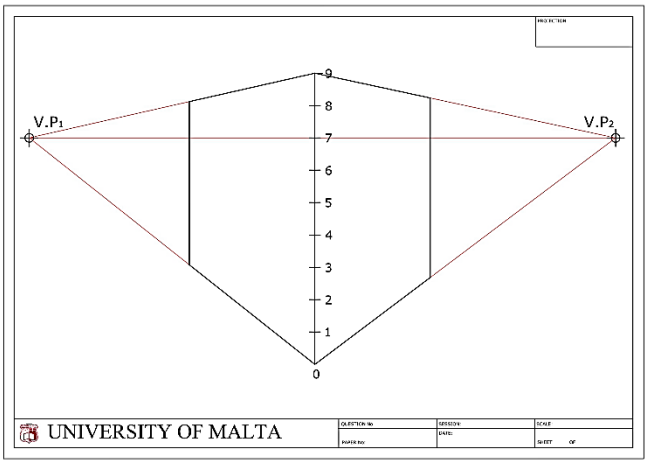


Figure 10c

Question 11

A private company is planning to start operating an 18-metre electric hybrid passenger boat ferry between Mgarr Gozo and the Grand Harbour in Valletta. The investors are planning to name this service Mixta Ferries. The investors are also planning to develop a mobile phone application so that one can easily access their schedule, travel information and to buy tickets. In advance of their investment, they analysed some data from the Malta National Statistics Office on Transport Statistics 2022.

Table 11.1: Sea Transport between Malta and Gozo: Q1/2022
[NSO Transport Statistics reference year 2022]
All data has been rounded to their nearest ten

Sea Transport to and from Mgarr and Valletta by month: 2022				
Trips	**Month**	**Valletta - Mgarr**	**Mgarr - Valletta**	**Total**
	January	230	260	490
	February	210	240	450
	March	290	290	580

Table 11.2: Sea Transport between Malta and Gozo: Q1/2022
[NSO Transport Statistics reference year 2022]
All data has been rounded to their nearest hundred

Sea Transport to and from Mgarr and Valletta by month: 2022				
Passengers	**Month**	**Valletta - Mgarr**	**Mgarr - Valletta**	**Total**
	January	8,200	9,500	17,700
	February	11,100	11,900	23,000
	March	12,800	13,700	26,500

You are required to design a poster. Your presentation must follow the steps given below and organised as suggested in Figure 11.

a) Label the poster with the heading "Mixta Ferries". (2)

b) Draw **THREE** graphic app icons to use as a mobile phone application, making it easier for the commuters to find this application on their mobile phone. The icons should be simple and should reflect the company identity being environ mental friendly ferry for passengers with outdoor decking to enjoy the scenery. Sketches to develop ideas can be drawn on the side of your A2 sheet. (8)

c) Draw a bar chart on your poster showing the number of trips made from Valletta to Mgarr and from Mgarr to Valletta during the months of January, February and March. Refer to Table 11.1. (4)

d) Draw a line graph showing the number of passengers that have travelled from Valletta to Mgarr and from Mgarr to Valletta during the months of January, February and March. Refer to Table 11.2. (4)

e) Draw a pie chart showing the total number of trips done during the months of January, February and March. Refer to Table 11.1. (4)

Question continues on next page.

f) Finalise your designed poster. The poster is expected to have a visual impact and carry the intended message clearly. (2)

Special consideration is to be given to the following:

i. the use of colour and shading to render the drawing;
ii. the use of typography (fonts);
iii. the formation of an attractive presentation, clearly conveying the information.

(Total: 24 marks)

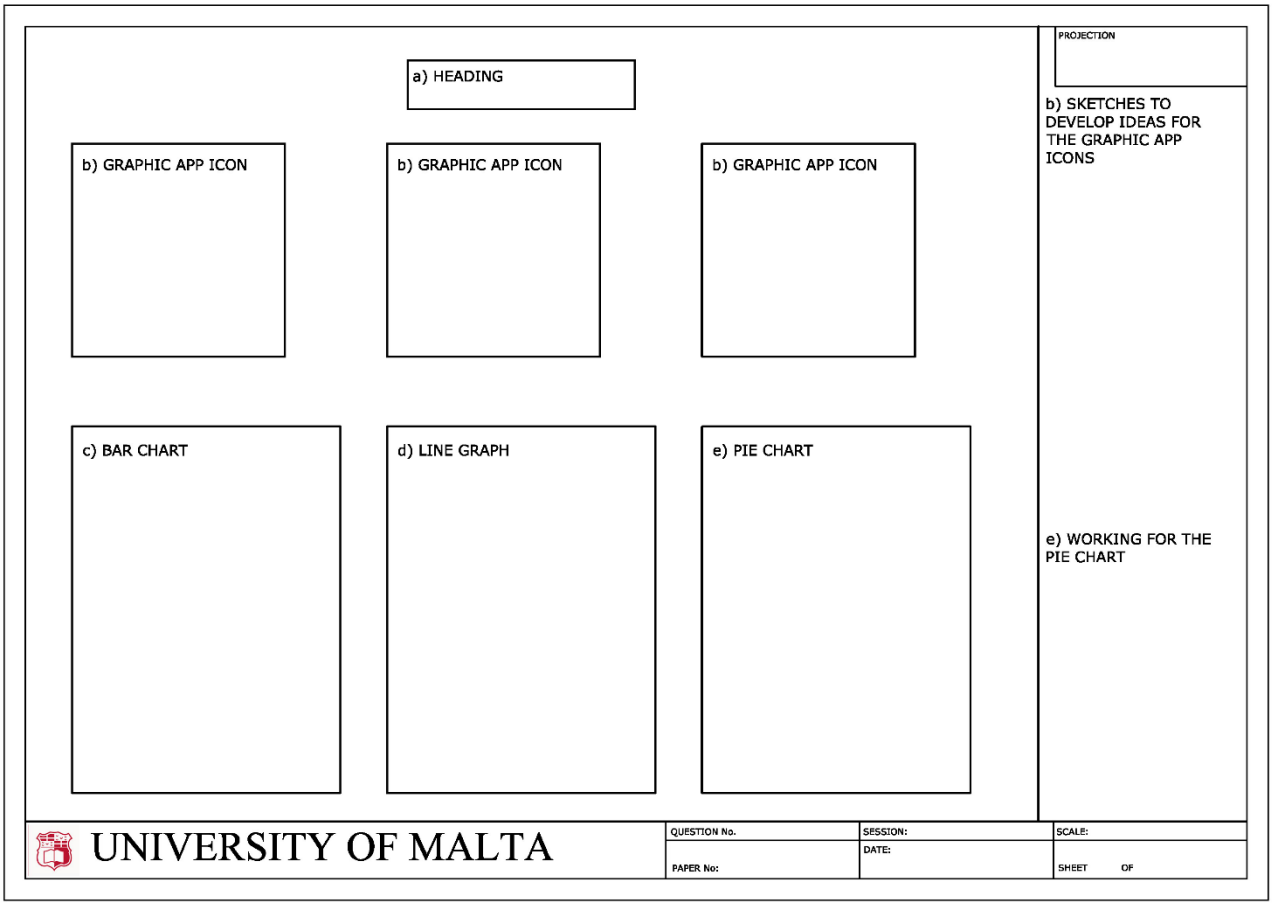


Figure 11

Question 12

A pictorial view of a study is shown in Figure 12a. An orthographic projection of the study is shown in Figure 12b. The study consists of a corner desk with four drawers, a free standing three drawer cabinet underneath the table, two long bookshelves, a magazine rack, an air conditioner and a semi – circular window.

a) Use the dimensions given in the orthographic projection to construct an estimated one-point perspective of the room. The viewing direction required is indicated by the arrow in the plan. (21)

b) Render in colour your drawing to enhance its presentation. (3)

(Total: 24 marks)

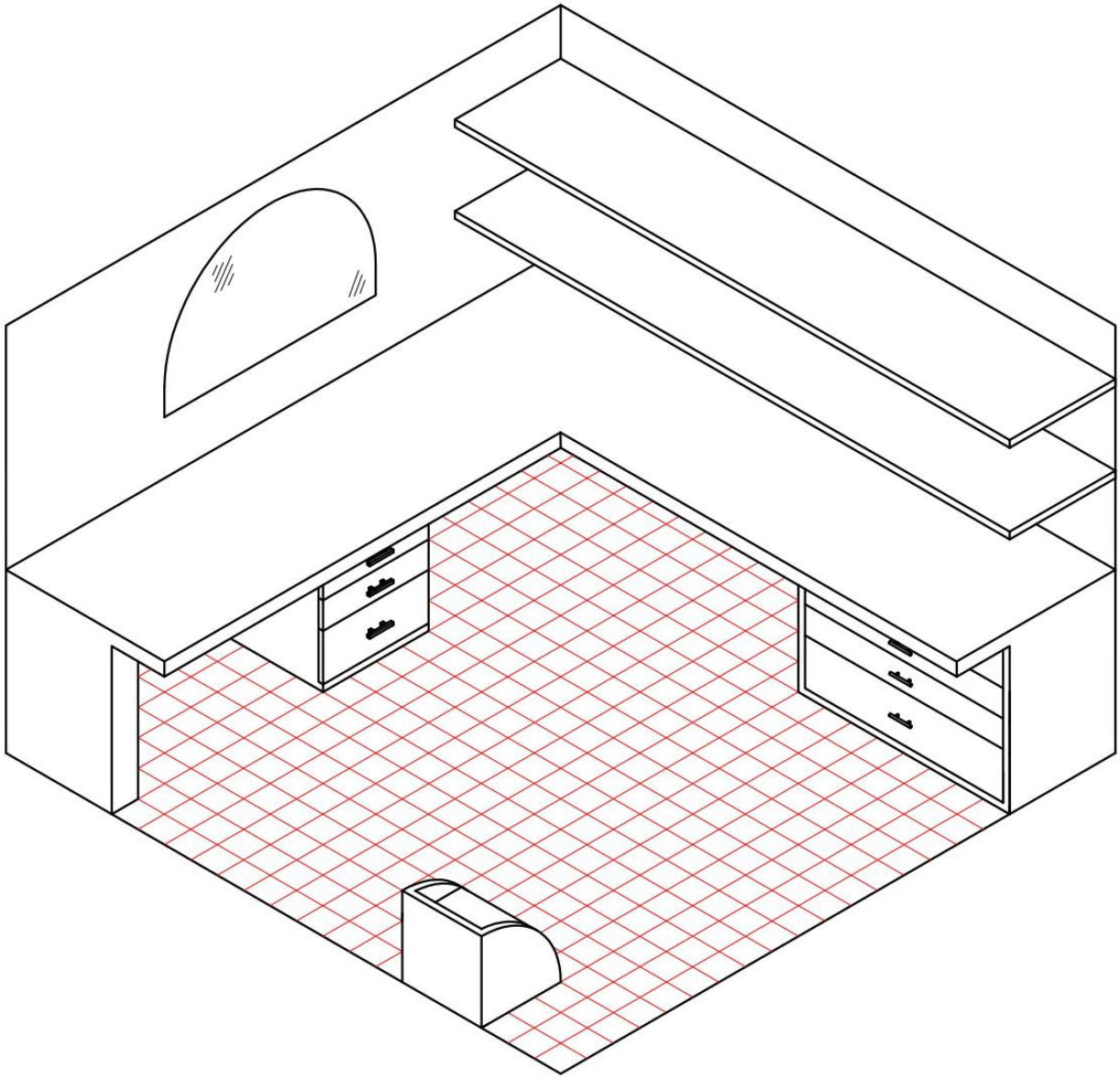


Figure 12a

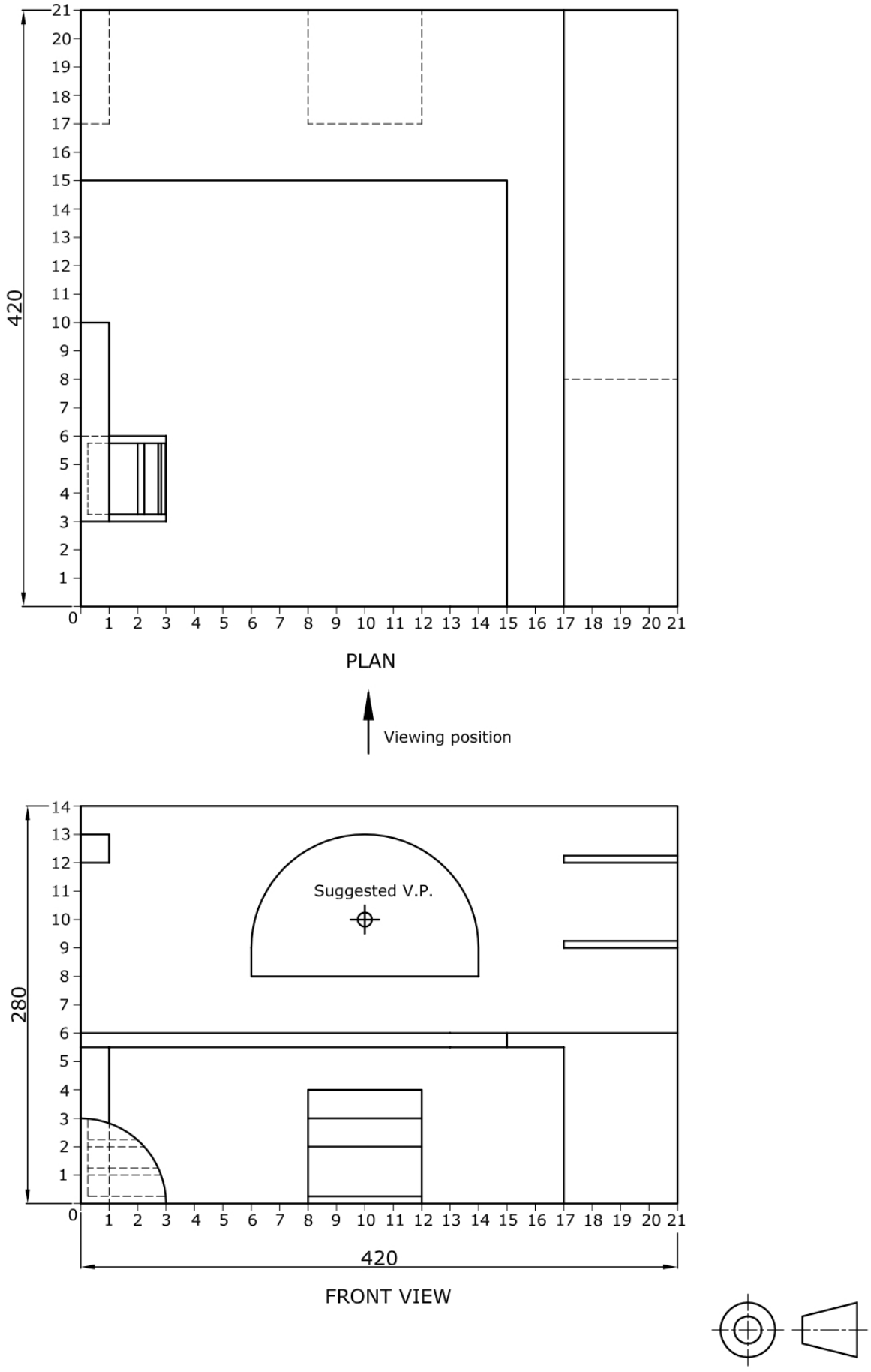
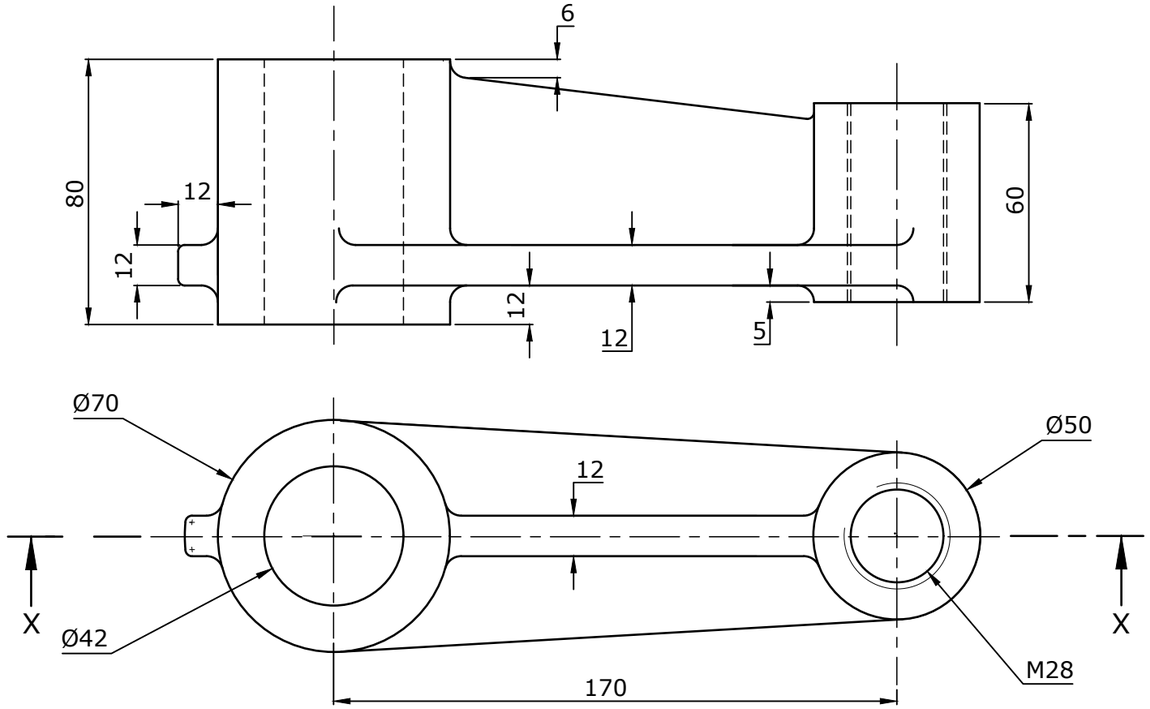
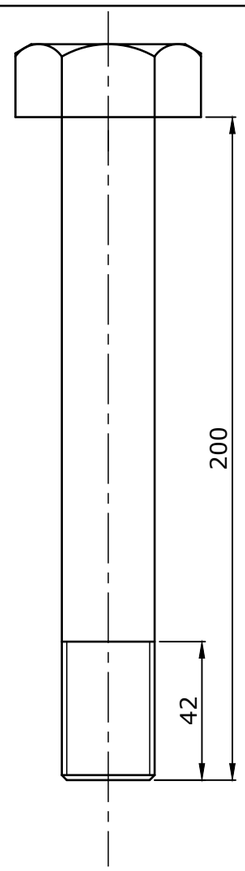


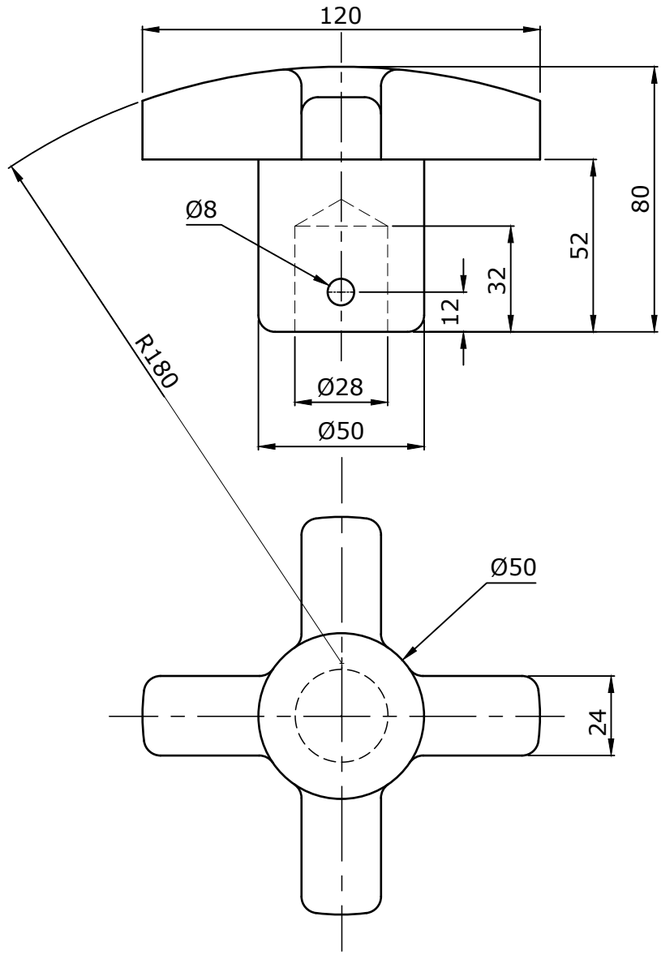
Figure 12b



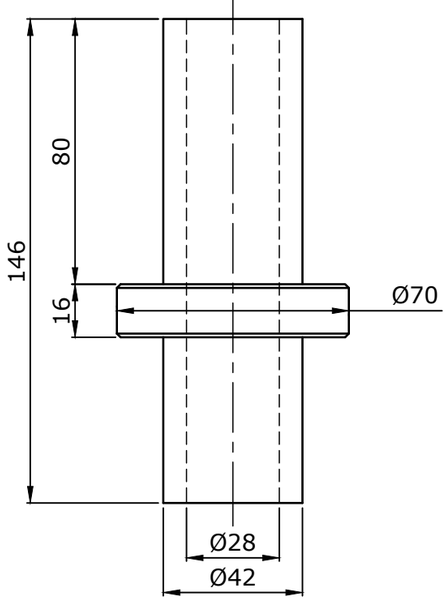
(Item 1) BODY



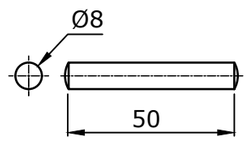
(Item 4) M 28 BOLT



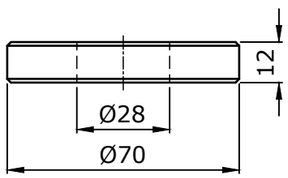
(Item 6) KNOB



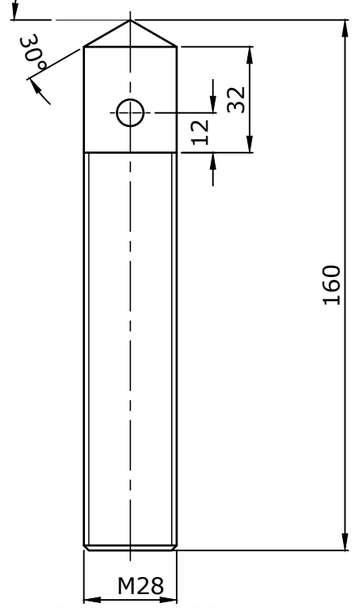
(Item 2) BUSH



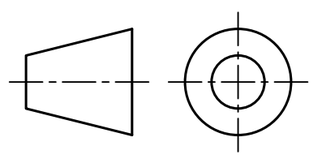
(Item 7) PIN



(Item 3) WASHER

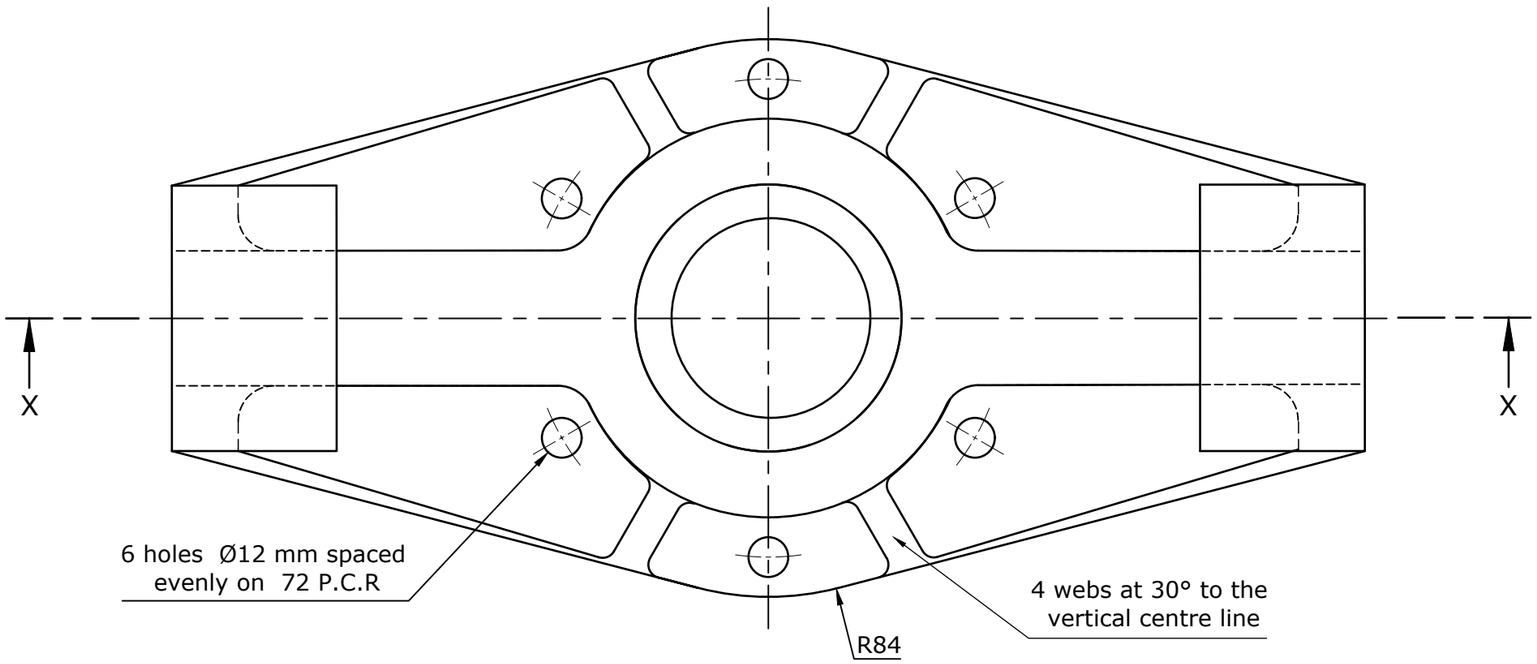


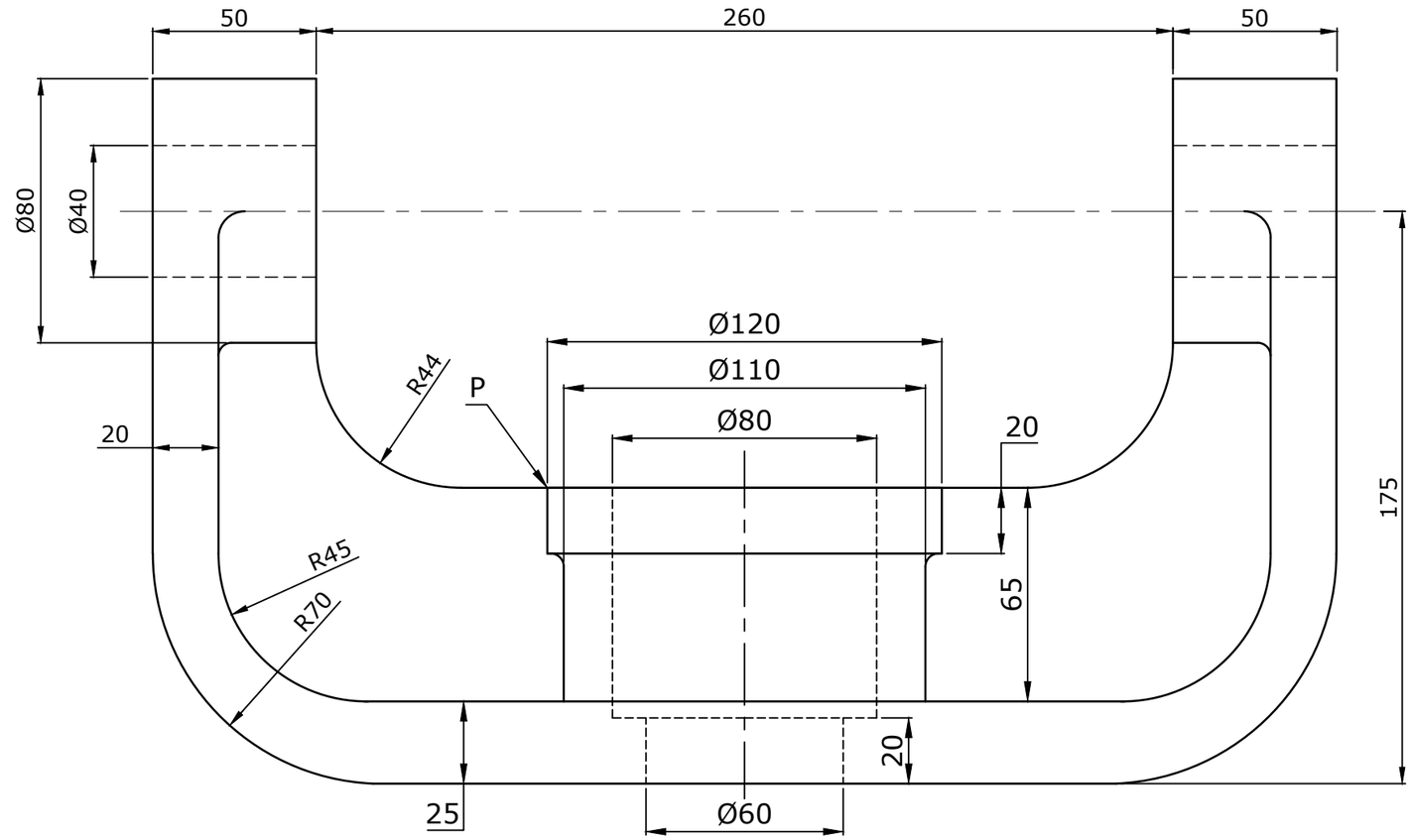
(Item 5) STEM



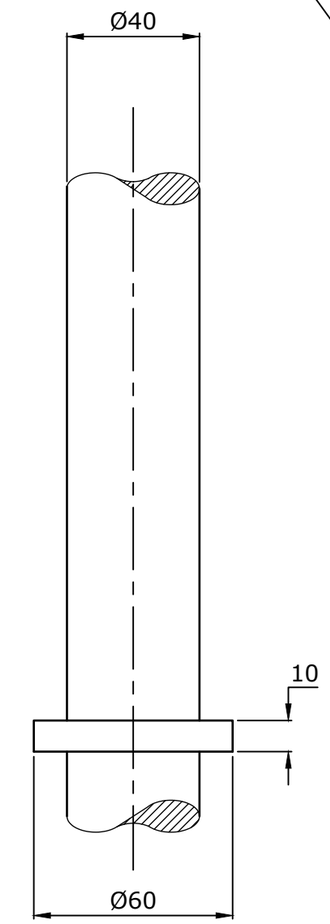
CLAMP

UNIVERSITY OF MALTA	MATRICULATION CERTIFICATE EXAMINATION	IM 09.22S	ENG DRG & GRAPH COMM SEC B QUES 7 FIG. 7b

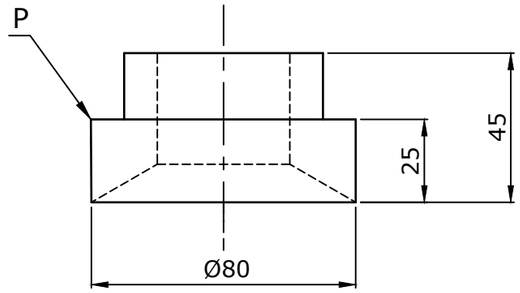




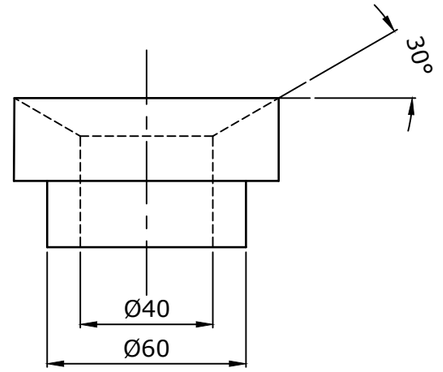
(ITEM 1) FRAME



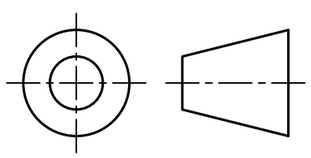
(ITEM 2) SPINDLE



(ITEM 4) BUSH



(ITEM 3) BUSH



SLUICE VALVE

UNIVERSITY OF MALTA	MATRICULATION CERTIFICATE EXAMINATION	IM 09.22S	ENG DRG & GRAPH COMM SEC B QUES 8 FIG. 8b